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An Examination of the Difference Between the CPI and the PCE Deflator

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An Examination of the Difference Between the CPI and the PCE Deflator

Abstract: Both the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA) produce measures of the change in prices that consumers pay on the goods that they consume. While these measures tend to agree in broad historical trends in prices, they sometimes give different pictures of inflation over short horizons.

There are several reasons why these two indexes differ. First, the two indexes use different formulas. For the period in question, the CPI is a Laspeyres index, while the BEA product is a Fisher Ideal index. Second, the two indexes have different underlying concepts. The BLS product measures the prices paid by (urban) consumers, while the BEA product measures the prices of final consumption goods, wherever they are purchased. Finally, even when there is significant agreement across indexes in the broad outlines of coverage, differences in how the detailed components are implemented lead to differences in how prices are measured and differences in the weights attached to specific series.

We quantify the magnitudes of each of these factors. There is no one "smoking gun" that explains the discrepancy between the indexes. Rather, the overall discrepancy is the result of the accumulation of a number of small effects.

An Examination of the Difference Between the PCE Deflator and the CPI

By Dennis Fixler and Ted Jaditz

Introduction

In the U.S., there are two major index programs measuring the change in prices that consumers pay on the goods that they consume. One is the Consumer Price Index (CPI), produced by the Bureau of Labor Statistics. The other is comprised of two price indexes produced by the Bureau of Economic Analysis (BEA) to accompany the National Income Accounts for Personal Consumption Expenditures (PCE).

Recently, the BLS has received numerous inquiries regarding the differences in inflation rates measured by the Consumer Price Index for all urban consumers (CPI-U, or just CPI) and BEA's Implicit Price Deflator.[1] Accordingly, we seek to answer two questions: First, what accounts for this discrepancy? Second, is the discrepancy likely a transient phenomenon or a continuing trend?[2]

The discrepancy tends to vary over time. Figure 1 graphs the inflation rates of the two indexes from the second quarter of 1983 to the second quarter of 1997. There are several periods where the difference between the two inflation rates is large. Figure 1 also shows that in the past, these differences have tended to disappear after a few quarters. Over long periods, the two indexes give very similar measures of the trend in prices: At the highest level of aggregation, over the period from II 1983 to II 1997, the average difference between the CPI and PCE inflation rates has been less that 0.1 percent per year.

While these measures tend to agree in broad historical trends, there are reasons why the two indexes may not give the same measure of price change over a given interval. First, they are

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[1] The Implicit Price Deflator is one of two main BEA indexes of inflation. The other BEA product is the Chain Price Index. The BEA holds that the chain price index is their featured price index and therefore it should be viewed as the basis for any comparison to the CPI. In principle, we agree. Recently, the discrepancy between the CPI-U and the Deflator has been larger and attracted more attention from the public and the economics profession. Hence, that is the difference we address here.

[2] The magnitude of these discrepancies fell markedly with the July 1997 revision in methodology. Nevertheless, the change in methodology did not eliminate some fundamental reasons for a difference between the measured rate of inflation provided by these two indexes. These reasons are the focus of our attention.

constructed using different formulas. Because of this difference in formula, even if the two indexes were built out of the same components, they would not necessarily agree on the measure of changes in prices. Second, the two indexes do not have the same components: there are differences in measurement objectives across programs, and thus there are significant differences in how prices are measures and weighted across the two indexes.

We start with the difference in formula. The CPI is a fixed weight Laspeyres price index. The PCE Deflator is derived from deflation by a Fisher Ideal quantity index. The Deflator is in effect the average of a Laspeyres price index and a Paasche price index. Since the Paasche price index generally lies below a Laspeyres price index, one might expect that the Deflator will generally measure less inflation than the CPI.

The two indexes also differ in their underlying conceptual framework or to put it simply, their scope. The Personal Consumption Expenditures account in the National Income and Product framework measures the goods and services purchased by persons, individuals, and non-profit institutions.[3] In contrast the CPI measures the out-of-pocket expenditures of urban households. It follows that the goods and services in the PCE Deflator should be a superset of the goods and services in the CPI.[4] As a result, there are numerous items included in the PCE deflator which are completely out of scope of the CPI. Some examples are military clothing, final expenditures by museums and libraries, and food furnished and consumed on farms. Earlier papers also examine the importance of the differences in scope and item definition.[5]

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[3] See "Personal Consumption Expenditures" Methodology Paper Series MP-6, US Department of Commerce, June 1990.

[4] In practice, this is not quite the case. When one maps the prices and weights of the PCE into the CPI, there are a small number of items that receive positive weight in the CPI that receive no weight in the PCE Deflator. Two examples are SE6204 "Fees for Lessons and Instruction" and SE51, "Automobile Finance Charges."

This occurs because the two indexes have different aggregation trees, and hence make different calls about how to organize economic activity. In the CPI, for example, automobile finance charges are included in the transportation section of the aggregation tree. BEA collects all financial services in the "Personal Business Services" section of the national accounts. In this particular case, BEA uses a CPI index SE6802 "Personal Financial Services" to deflate the relevant financial services section of the national accounts. That is a reasonable choice; however, note that the information used to calculate the BLS automobile finance charge index will not appear anywhere else in the BLS aggregation tree, and thus that information is lost to the national accounts.

In any event, the aggregate weight of the categories so affected in the CPI is quite small.

[5] See for example, Jack E. Triplett, "Reconciling the CPI and PCE Deflator," Monthly Labor Review (September, 1981) pages 3-15, and "Reconciliation of Quarterly Changes in Measures of Prices Paid by Consumers," Survey of Current Business, March 1978.

Appendix Table 4 presents the list of items that are included in the PCE but completely beyond the scope of the CPI. This list is taken from Parker (1994).[6] These items are not included, either in whole or in part, in the market basket which makes up the CPI.

There are several other items that are defined differently across programs and hence do not overlap perfectly. When there is significant overlap in category definition across indexes, we choose to treat the result as a difference in weighting and/or prices, rather than a difference in scope. We therefore do not exclude these items when calculating the scope correction. To illustrate, consider the CPI category "Physician Services" and the PCE category "Physicians." The CPI focuses on the out-of-pocket expenditures of households as determined from the Consumer Expenditure Survey, though it makes an adjustment for expenditures paid for by third parties (insurers) by allocating their expenditures to the various CPI medical categories. In contrast, the current dollar value for PCE physicians includes third party payers (private and public) directly and comes from the Census of Service Industries, the Health Care Financing Administration, and the Census Bureau's Annual Survey of Services.

As a result, the PCE category "Physicians" has a much greater weight in the PCE than "Physicians Services" has in the CPI. In 1996, the PCE category "Physicians" accounted for about 3.77% of the total spending that falls within the scope of the PCE Deflator. In the same year, "Physicians Services" spending accounted for a budget share of 1.89% of the CPI market basket.[7] Even if the two indexes used the same measure of price for this category, this difference in weights would mean that the two indexes would not track perfectly.

For many categories of items, the CPI and the PCE Deflator have similar conceptual definitions, and BEA often uses the corresponding CPI index for deflation. For the physicians services category, however, BEA uses the Producer Price Index for Physicians instead of the CPI "Physicians Services" index. Given the difference in coverage, this is valid and sensible choice. However, note that even if the two indexes had the same weight for this category, the use of different measures of price change means that the two indexes will not track perfectly.

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[6] Robert Parker, "Substitution Effects in Measures of Consumer Prices: From the CPI and Personal Consumption Expenditures." Internal BEA Memo to Carol Carson, January 5, 1994.

[7] The figure for the CPI is the 1996 relative importance for Physicians Services. See Note 13 for a discussion of the difference between the relative importance and an actual expenditure weight.

Others might use different criteria to decide which categories warrant matching, and which are so dissimilar that they should be excluded as scope differences. Different assumptions will lead to different results. However, we can address questions such as: How much of the difference in the CPI and the PCE Deflator is due to differences in the weight placed on physicians services -- regardless of the differences in how physicians services are counted within each index? How much is due to different measures of prices for this category?

We find that there is no one "smoking gun" that accounts for the entire discrepancy between the two indexes. The discrepancy is caused by an accumulation of many small factors. All of the factors we discuss — differences in formula, differences in scope, and differences in weights and prices — contribute to the discrepancy in varying degrees.

Our analysis proceeds as follows. To quantify the formula effect, we use publicly available data from the National Income and Product Account tables to construct a fixed-weight Laspeyres price index out of the same data used to construct the PCE Deflator. The difference between the PCE Deflator and the Laspeyres construct is used to estimate how much of the difference between the two indexes is due to the difference in formula.

Second, we drop those items that are completely out of scope of the CPI, leaving a fixed weight index that is on the same conceptual footing as the CPI. Third, we construct an exact decomposition of the remaining difference between the CPI and our fixed weight, scope adjusted Laspeyres PCE price index. We identify every difference in the weights and sources of prices for similar items across the two indexes. It is important to keep in mind that this decomposition is a simple accounting of the difference between the two indexes; neither the validity of weight and price differences nor the relative merits of the two indexes is at issue.

Differences in Formula

While the CPI is a Laspeyres price index, the PCE Deflator is a derived index. The PCE obtained by deflating the ratio of PCE expenditures from two periods with a quantity index. Until recently, the PCE Deflator was computed with by deflating with a Laspeyres quantity index. In 1995 the BEA moved from the Laspeyres index formula to a chain Fisher index formula for the quantity index.

The implicit PCE Deflator derives from a property of index numbers called the product test: between periods t and t+1, the product of a price index and a quantity index yields the ratio of expenditures in t+1 to expenditures in t. To illustrate, let the price of good i in period t be p_i^t, and the quantity of good i in period t be q_i^t. Total expenditures in period 1 would be $\sum p_i^1 q_i^1$, while total expenditures in period 2 would be $\sum p_i^2 q_i^2$. The Fisher Ideal index formula satisfies the product test:

$$\sum p_i^2 q_i^2 / \sum p_i^1 q_i^1 = F_p^{1,2} F_q^{1,2}$$

where $F_p^{1,2}$ and $F_q^{1,2}$ are the Fisher Ideal price and quantity indexes, respectively. The PCE deflator is the Fisher Ideal implicit price index obtained by dividing the ratio of expenditures by a Fisher Ideal quantity index. That is,

$$(\sum p_i^2 q_i^2 / p_i^1 q_i^1)/ F_q^{1,2} = F_p^{1,2} .$$

The Fisher Ideal quantity index is the geometric mean of a Laspeyres quantity index and a Paasche quantity index. Pursuing our example, we have the Laspeyres quantity index

$$L_q^{1,2} = \sum p_i^1 q_i^2 / \sum p_i^1 q_i^1 .$$

Deflating revenues by a Laspeyres quantity index leads to the price index

$$(\sum p_i^2 q_i^2 / \sum p_i^1 q_i^1) / (\sum p_i^1 q_i^2 / \sum p_i^1 q_i^1) = \sum p_i^2 q_i^2 / \sum p_i^1 q_i^2 ,$$

which is the Paasche price index between periods 1 and 2. Similarly, one can show that deflating by the Paasche quantity index

$$P_q^{1,2} = \sum p_i^2 q_i^2 / \sum p_i^2 q_i^1 ,$$

yields a Laspeyres price index. The Fisher ideal quantity index is the geometric mean of the Laspeyres and Paasche quantity indexes:

$$F_q^{1,2} = (L_q^{1,2} P_q^{1,2})^{0.5}$$

and the corresponding price index will generally lie between a Paasche and a Laspeyres price index. Thus, inflation rates reported by a Fisher Ideal index is generally less than the inflation rates given by a Laspeyres index.[8]

[8] Aizcorbe and Jackman "The Commodity Substitution Effect in CPI Data, 1982-91" Monthly Labor Review December 1993 showed that a Fisher based CPI showed a smaller rate of inflation than the Laspeyres based CPI.

To implement the Fisher Ideal index, both price and quantity data are required for both periods for which one wants to calculate the index. In practice, price information is available on a more timely basis than the current dollar information used to construct the quantity weights. To publish an index in a timely manner, the current index must be calculated using provisional data. In part to accommodate this, BEA indexes have a "tail period," during which indexes are calculated using a slightly different approach than is used for the historical series. With the July, 1997 revision, the computation of indexes in the tail period was changed: the major difference concerns how current nominal value information is incorporated into the index.[9]

Typically, each summer, BEA revises the tail indexes. The earliest four quarters of the tail period are recalculated using updated nominal values data and using the methodology of the historical series. The remaining quarters are "re-chained" to the new values of the revised series. The current tail period, which will be revised in July, 1998, starts in quarter III 1996 and ends in quarter I 1998. At that time, the data from III 1996 to II 1997 will be revised and added to the historical series, and the new tail period will then run from III 1997 to I 1999.

The use of chaining is another way in which the PCE Deflator differs from the CPI-U. More specifically, the PCE Deflator is calculated by "chaining" one period indexes: the Fisher price index $F_p^{1,3}$ is calculated by multiplying together two one-period Fisher price indexes:

$$F_p^{1,3} = F_p^{1,2} F_p^{2,3}.$$

In contrast, the CPI is a fixed-base-period index, though it is chained at decennial revisions. Thus the CPI index for comparing period 1 to period 3 prices would be calculated directly:

$$L_p^{1,3} = \sum p_i^3 q_i^1 / \sum p_i^1 q_I^1.$$

If the CPI were chained like the PCE, then there would be a substantive change in the underlying economic concept. The CPI attempts to measure the minimum level of expenditures needed by a representative consumer to achieve a given level of utility in a given base period. For a chained index, the reference utility level used to measure inflation is changing every period.

To estimate the importance of differences in formula, we re-calculate the BEA index as a fixed-weight Laspeyres price index. For the weights, we use the 1992 average annual expenditures,

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[9] Prior to the July, 1997 revision, the BEA did not use the Fisher formula in the tail period. The price deflator for the tail period was calculated using a Laspeyres quantity index. This means that during the tail period, the deflator was essentially a chained Paasche index. Starting with the July, 1997 revision, the BEA now uses the Fisher formula throughout the series.

divided by total 1992 personal consumption expenditures.[10] We calculate this index using the same price data used by BEA to construct the PCE deflator. We chose 1992 because it is the benchmark year for the BEA data. As discussed below, we rebase the CPI to 1992 as well.

We performed the computation for highest level aggregate and for each of the major components: Durables, Non Durables, and Services. Tables 1 through 4 report the results of the analysis for each index in turn. In the "Inflation Rates" section of the table, Column 2 gives the (annualized) quarter to quarter inflation rate calculated from indexes reported by the BEA. Column 3 gives the inflation rate calculated from the fixed weight approximation to the PCE deflator. In the "Difference Analysis" section, column 2 gives the difference between the CPI index and the BEA PCE deflator. Column 3 gives the difference between the inflation rate calculated from the fixed weight PCE deflator and the inflation rate reported by BEA. The last two lines of the "Difference Analysis" section reports the averages of the quarterly differences over the entire period.

As one might expect, the fixed weight PCE is generally larger than the Fisher based PCE and so the difference between the CPI inflation rate and the PCE inflation rate falls with the use of a Laspeyres formula instead of a Fisher formula. As seen in Table 1, the average difference in the annualized overall inflation rates between the PCE Deflator and the CPI is 0.22% per year. Recalculating the PCE deflator as a fixed weight Laspeyres price index rather than a Fisher would increase the PCE deflator by an average of 0.14% per year—thus eliminating two thirds of the total difference (on average). Looking at Tables 2, 3 and 4, the impact on the sub-indexes is qualitatively the same, with the greatest difference observed in the durable goods sub-index.

Finally, as can be seen from Tables 3 and 4, the cases of Non Durable Goods and Services do not appear to have large differences between the BEA published deflator and the CPI. Consequently we do not discuss these two types of goods further.

Differences in Scope

To estimate how scope differences contribute to the overall discrepancy between the PCE and the CPI, we remove from our fixed weight PCE all of the lines listed in Appendix Table 4. Column 4 in the "Inflation Rates" section of Tables 1 through 4 reports the inflation rate derived

[10] The BEA also produces a quarterly fixed weight price index benchmarked to 1992. The difference between the BEA index and our constructed fixed weight index is small. Since we used BEA data to construct our indexes, any difference is most likely due to rounding and differences in precision of the underlying data.

from this scope-adjusted index. Column 4 in the "Difference Analysis" section reports the difference between the scope-adjusted inflation rate and inflation rate calculated from a fixed weight PCE.

As can be seen from the "Overall Average" line in Table 1, the average scope adjustment is -0.2% per year. In other words, at the highest level of aggregation, the effect of adjusting the fixed weight PCE for the difference in scope is to *increase* the difference between the fixed weight PCE and the CPI inflation rates. The price inflation for these items is on average closer to the rate of inflation of the all items CPI than it is to the PCE Deflator. An effect of similar magnitude is present in the durable goods index; see Table 2.

Weights and Prices

The scope adjusted fixed weight PCE transforms the PCE as close as possible into an index with the same formula and objective as the CPI. The remaining differences can be essentially described as weight and price differences. Differences in how item definitions are implemented can lead to a difference in whether certain expenditures are included in the item category, and this leads to a difference in weights. These differences in definition can also lead the two agencies to use different measure of price change for similar categories.

Assuming that the same set of *j* commodities comprise each index, the difference between the CPI and the scope adjusted fixed weight PCE can be written as:

$$\text{CPI} - \text{PCE} = \sum w^j_{cpi} P^j_{cpi} - \sum w^j_{pce} P^j_{pce}$$

where *w* denotes the weight for the price relative *P*. Adding and subtracting $\sum w^j_{pce} P^j_{cpi}$ from the right-hand side yields

$$\begin{aligned}\text{CPI} - \text{PCE} &= \sum w^j_{cpi} P^j_{cpi} - \sum w^j_{pce} P^j_{cpi} + \sum w^j_{pce} P^j_{cpi} - \sum w^j_{pce} P^j_{pce} \\ &= \sum (w^j_{cpi} - w^j_{pce}) P^j_{cpi} + \sum w^j_{pce}(P^j_{cpi} - P^j_{pce}). \qquad (1)\end{aligned}$$

We refer to the first summand on the right-hand side as the *weight factor* and the second summand as the *price factor*.[11]

[11] This decomposition is not unique. One could form other decompositions by adding and subtracting alternative constructions. This decomposition was selected because it was the easiest to implement.

Even if the two indexes had the same weights, the differences in measures of price movement means that the two indexes do not necessarily move together. Holding weights fixed, the price factor is a measure of how the difference in component price indexes is translated into differences in the aggregate indexes. For a given component category, if the BLS and the BEA use the same measure of prices, then that category will not contribute to the difference in the overall aggregate indexes. Some categories have large differences in prices, but small weights; thus, their net contribution to the difference between the two indexes is small. For a category with large weight, even a relatively small difference in price movements may provide a large contribution to the overall difference between the aggregate indexes.

Even if the two indexes used the same set of indexes to measure price movement, the difference in weights applied to these prices would mean that the two indexes would not necessarily move together. The weight factor is a measure of how the difference in weights is translated to differences in the two aggregate indexes. Obviously, the weight factor will be zero if all of the weights are identical across indexes. Less obviously, the weight factor will be zero if all component price indexes move in the same proportion.[12] Even if weights differ across indexes, the weight factor will be non-zero only if various component indexes move in different proportions.

Using 1992 as the base year, the CPI between 1992 and II 97 is computed to be 114.12 and the scope adjusted fixed weight PCE for the same period is computed to be 112.32, implying that a difference of 1.8 index points needs to be explained. From the above equation, we can decompose this difference into a portion that is attributable to differences in weights, given a common price index, and a portion that is attributable to differences in prices, given a common set of index weights.

Comparing indexes in this manner requires the construction of a concordance. One requires a mapping of the lowest level dis-aggregates from one index into comparable components of the other index. Our concordance uses as its starting point information supplied by BEA listing the sources of the price information used to construct the PCE Deflator. This listing is contained in

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[12] Recall that P^{j}_{cpi} is the CPI price index for good j. Suppose that the CPI index increases by the same proportion for all categories: $P^{j}_{cpi} = 110$, say, for all j. Then, since $\Sigma\, w^{j}_{cpi} = \Sigma\ w^{j}_{pce} = 1$,

$\Sigma\,(w^{j}_{cpi} - w^{j}_{pce})\, P^{j}_{cpi} = \Sigma\,(w^{j}_{cpi} - w^{j}_{pce})\, 110 = \Sigma\, 110 * w^{j}_{cpi} - \Sigma\, 110 * w^{j}_{pce} = 110 - 110 = 0.$

Appendix Table 1. Where BEA does not use a BLS CPI source for their prices, we made judgment calls as to the most comparable BLS index.

Completing the concordance required mapping the weights used in the fixed weight scope adjusted PCE index to the comparable CPI category. This task is not straightforward. In some cases, a line from the BEA index might map to a CPI aggregate, while a different BEA line might map to one of the component a CPI indexes underneath the previous index in the CPI aggregation tree. When a BEA line uses an CPI aggregate index as a source for prices, we use the CPI aggregation tree to allocate the BEA weight over the various CPI dis-aggregate series underneath that CPI aggregate.

For reasons of computational convenience, the price factor is reported relative to the BEA PCE index categories, while the weight factor is reported according to the CPI index categories.

To conduct the analysis, we re-based each CPI component index to 1992=100 and used the 1992 relative importances as weights. The relative importances are the expenditure weights from the 1982-1984 Consumer Expenditure Survey, moved by the changes in the respective price indexes. The relative importances for a given period are thus the percent of the total expenditures in the (fixed) CPI index market basket accounted for by a given category. [13]

Most of the item prices used in the computation of the PCE are derived from the CPI. Differences in seasonal adjustment, however, leads to cases where the price factors are not zero even though both programs obtain their price data from the same source.

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[13] Observe that the relative importances are not the same as an expenditure weight that is derived from the Consumer Expenditure Survey. The principal difference is that the relative importance represents the dollar share of the cost of the fixed (1982-84) market basket, whereas the expenditure weight represent the share of consumer spending. Some information about the magnitudes of the differences are presented in the following table.

Expenditure Class/Item	1992 CES Weight	1992 Relative Importance
Food and Beverage	16.428	17.396
Housing	43.654	41.404
Apparel	6.442	6.005
Transportation	17.462	17.012
Medical Care	5.844	6.931
Entertainment	4.778	4.350
Other Goods and Services	5.392	6.902
Inform. Processing (Computers)	0.352	0.124

The Weight Factors. By allocating the weight from the adjusted PCE to corresponding CPI lines, we identify many large differences between the two indexes. Table 5 lists the items that have the greatest difference in weight, without considering the price term. As can be seen from the table, Owner's Equivalent Rent provides the largest single difference in weight; the CPI gives much more weight to this item. The PCE places greater weight on most medical services. Appendix Table 5 provides the complete list of the difference in weights, item by item, for every line in the CPI.

Why are there such large differences in weights? One factor is the different base periods for the two indexes. The constructed fixed weight PCE index uses the patterns of expenditures current in 1992, while the CPI weights are based on the 1982 consumer expenditure survey. The PCE weights therefore reflect changes in consumption patterns over the decade 1982-1992 not reflected in the CPI weights.

Another contributing factor is the differences in measurement objectives between the two indexes. Many of the largest differences in weights occur where sectors where third party payors are important. In the medical services categories, large expenditures by non-profit and government agencies are in the scope of the PCE and out of scope of the CPI, and this certainly accounts for a large part of the difference.

The total weight factor for all items for the period to II 97 is -0.16. For the period from 1992 to II 97, if one used the same price indexes to calculate the CPI and the scope adjusted fixed weight PCE index, the differences in weights would result in the CPI being 0.16 points *lower* than the PCE, ignoring the price factor. This implies that on average, the CPI tends to place slightly greater weight on categories where prices are accelerating more slowly, and slightly less weight on categories where prices are accelerating more quickly – where "quickly" and "slowly" are measured using the CPI price indexes.

Calculating the contribution of individual items to the overall weight factor takes some care. If all prices change in the same proportion, individual lines will have non-zero weight factors, while the aggregate weight factor will be zero. To adjust for this effect, we measure the weight factor for line j of the CPI as

$$(w^j_{cpi} - w^j_{pce})\,(P^j_{cpi} - \bar{P})$$

where $\bar{P}$ is the (weighted) mean value of the CPI indexes in the comparison period.[14]

Table 6 contains the largest weight factors. (Appendix Table 5 lists the weight factors for every line of the CPI.) Table 6 contains every line in the CPI for which the weight factor contributes at least 0.05 index points to the difference in the CPI and the fixed weight scope adjusted PCE over the period 1992-II 1996.

The Price Factors. Consider now the role of differences in measures of prices.[15] In many cases, the BEA and BLS use different measures of prices for more or less comparable line items. Thus, even if the weights for the two indexes were the same, differences in measures of price change could lead to differences in the resulting indexes.

Table 7 lists the BEA categories with the largest differences in index points between the indexes used by the BEA to measure price movements and the comparable CPI indexes. For Airlines, Computers, and Private Higher Education, the BLS and BEA use different measures of price change and their indexes differ by 20 points over a period of a little less than four years. Table 7 contains every line in the PCE deflator where the difference in underlying indexes is greater than one index point over the period. (Appendix Table 5 contains a complete listing of the differences in index values for every line in the PCE deflator.)

The calculated price factor is a measure of how much these differences in prices contribute to the differences between the two indexes, given a common weight structure. Differences in measures of price movement account for 1.97 index points of the difference between the CPI and the

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[14] Since $\sum w^j_{cpi} = \sum w^j_{pce} = 1$, $\sum (w^j_{cpi} - w^j_{pce})\,(P^j_{cpi} - \bar{P})$

$$= \sum (w^j_{cpi} - w^j_{pce})\,P^j_{cpi} - \sum (w^j_{cpi} - w^j_{pce})\,\bar{P}$$

$$= \sum (w^j_{cpi} - w^j_{pce})\,P^j_{cpi} - (\sum w^j_{cpi} - \sum w^j_{pce})\,\bar{P}$$

$$\sum (w^j_{cpi} - w^j_{pce})\,P^j_{cpi}$$

so that the sum of the weight factors does not change.

[15] Jack Triplett and Stephen Merchant in "The CPI and the PCE Deflator: An Econometric Analysis of Two Price Measures," Annals of Economic and Social Measurement, Vol.2/3, 1973, 263-282, also look at the differences in behavior between 21 PCE component prices that come from the CPI and the source CPI component. For 15 of the 21 components, they "reject, wholly or partly, the 'general hypothesis' that PCE components present the same economic picture drawn by their counterpart measures in the CPI."

PCE. Relative to an average calculated using PCE weights, the price indexes used to calculate the CPI tend to grow faster than the price indexes used to calculate the scope adjusted fixed weight PCE index. Table 8 gives the largest price factors between 1992 and II 97. Every line with a price factor rounding to 0.01 or greater is included in Table 8.

Observe that although computers are listed in Table 7, the magnitude of its price factor is not that great; the computer price factor suggests that it is responsible for only 0.11 of the index point difference. Thus even though the differences in computer prices is the largest one in Table 7, the weight is so small that the net effect is small.

Summary and Conclusions

We have sought to examine the difference between the CPI and the PCE with particular attention to the reported increase in the difference between the two price indexes. Generally the difference between them can be traced to differences in formula, differences in scope and differences in the component prices and weights. We have examined the impact of each of these sources of differences.

Our findings are summarized in Table 9. For the period 1992 to II 97, the difference between the CPI, 114.12, and the published (Fisher) PCE, 112.47, is 1.65 index points. We decompose this difference into formula, scope, price, and weight effects as follows:

If the PCE deflator was recalculated as a fixed weight, fixed base-period Laspeyres Index, the value of the index would be 113.33. Thus, about 0.86 of the difference between the two indexes over this period is attributable to the differences in formula used in each.

The scope-adjusted fixed weight PCE takes a value of 112.32 in II 1997. The figure –1.01 is an estimate of the difference in the two indexes attributable to differences in the scope of the indexes. If we dropped from a fixed weight analog of the PCE the items that are included in the PCE but have absolutely no counterpart in the CPI, the difference between the two indexes would be would be 1.01 points *larger*.

The difference between the CPI and the scope-adjusted fixed weight analog to the PCE Deflator is 1.80 index points. This difference can be decomposed into a weight effect and a price effect. If the two indexes had the same weights on the comparable categories, the difference between the two indexes would be a total of 0.16 points larger. If the two indexes had the same prices for

comparable categories, the difference would be 1.97 points smaller. The remaining residual, -0.01 index points, is an unexplained residual, likely attributable to rounding error.

We conclude that the discrepancy between the two indexes is due to the difference in formula and the difference in measures of price change. Empirically, over the period 1992 to II 1997, the scope effect and the weight effect worked to counter the formula effect and the price effect and attenuate the difference between the two indexes.

In our examination of weight and price effects we found that items related to medical care, such as hospitals, physicians, and health insurance, play a significant role within both the weight effect and the price effect for the time periods examined. We also showed that even in some instances where there happened to be relatively large price (weight) differences between items, as with computers, the effect on the difference between the CPI and the PCE tended to be small.

Figure 1.
PCE Deflator v. CPI "All Items" Annualized Rates of Inflation over Time.

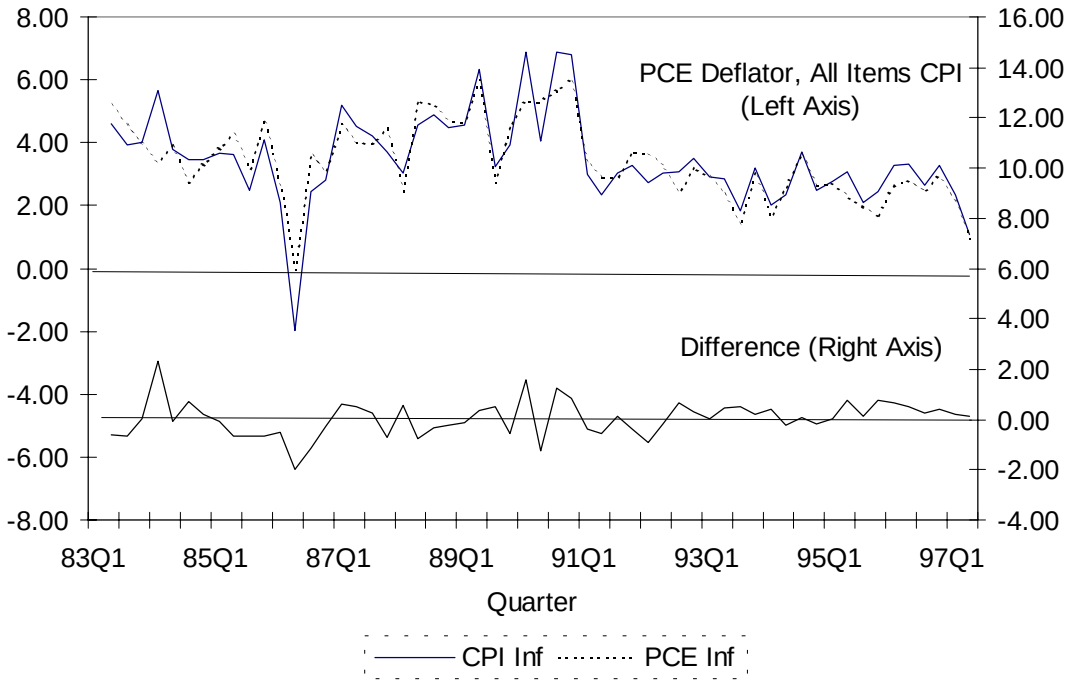

Table 1
Summary of Adjustments to PCE Deflator (Line 1 of Table 206I)

		BEA	Fixed Weight	Scope Correction	CPI
	(1)	(2)	(3)	(4)	(5)
Inflation Rates	I 92	3.67	3.67	3.22	2.73
	II 92	3.24	3.16	2.83	3.03
	III 92	2.41	2.46	2.1	3.05
	IV 92	3.19	3.23	3.48	3.51
	I 93	2.89	2.93	3.13	2.92
	II 93	2.4	2.47	2.37	2.90
	III 93	1.37	1.42	1.6	1.83
	IV 93	3.04	3.08	2.82	3.22
	I 94	1.62	1.69	1.89	2.04
	II 94	2.58	2.71	2.19	2.33
	III 94	3.63	3.63	3.19	3.73
	IV 94	2.65	2.84	1.93	2.49
	I 95	2.75	2.92	2.7	2.77
	II 95	2.32	2.59	2.19	3.09
	III 95	1.97	2.05	1.98	2.10
	IV 95	1.66	1.83	1.94	2.46
	I 96	2.61	2.83	2.93	3.25
	II 96	2.82	3.2	2.95	3.36
	III 96	2.43	2.8	1.85	2.66
	IV 96	2.92	3.24	3.07	3.31
	I 97	2.15	2.39	2.49	2.33
	II 97	0.96	1.13	1.05	1.09

		Overall Difference	Fixed Weight	Scope Adjustment	Residual
	(1)	(2)	(3)	(4)	(5)
Difference	I 92	-0.94	0.00	-0.45	-0.49
Analysis	II 92	-0.21	-0.08	-0.33	0.20
	III 92	0.64	0.05	-0.36	0.95
	IV 92	0.32	0.04	0.25	0.03
	I 93	0.03	0.04	0.20	-0.21
	II 93	0.50	0.07	-0.10	0.53
	III 93	0.46	0.05	0.18	0.23
	IV 93	0.18	0.04	-0.26	0.40
	I 94	0.42	0.07	0.20	0.15
	II 94	-0.25	0.13	-0.52	0.14
	III 94	0.10	0.00	-0.44	0.54
	IV 94	-0.16	0.19	-0.91	0.56
	I 95	0.02	0.17	-0.22	0.07
	II 95	0.77	0.27	-0.40	0.90
	III 95	0.13	0.08	-0.07	0.12
	IV 95	0.80	0.17	0.11	0.52
	I 96	0.64	0.22	0.10	0.32
	II 96	0.54	0.38	-0.25	0.41
	III 96	0.23	0.37	-0.95	0.81
	IV 96	0.39	0.32	-0.17	0.24
	I 97	0.18	0.24	0.10	-0.16
	II 97	0.13	0.17	-0.08	0.04
	Average	0.22	0.14	-0.20	0.29
	St. Dev.	0.40	0.13	0.34	0.36

Table 2.
Summary of Adjustments to PCE Deflator Durable Goods (Line 36 of Table 206I)

		BEA	Fixed Weight	Scope Correction	CPI
	(1)	(2)	(3)	(4)	(5)
Inflation Rates	I 92	2.02	1.81	1.87	2.48
	II 92	1.61	1.9	1.66	3.07
	III 92	0.4	0.17	-0.04	2.04
	IV 92	0.4	0.63	0.26	2.59
	I 93	1.08	1.04	0.93	0.52
	II 93	1.91	2.2	1.78	3.01
	III 93	1.66	1.8	1.31	3.10
	IV 93	2.56	2.83	2.54	3.74
	I 94	1.02	1.11	1.15	1.08
	II 94	2.78	3.05	2.86	3.54
	III 94	3.3	3.6	3.17	4.09
	IV 94	0.39	0.84	0.28	2.65
	I 95	1.42	1.97	1.8	2.85
	II 95	0.12	0.69	0.56	2.35
	III 95	-0.23	0.4	0.61	0.63
	IV 95	-0.42	0.29	0.15	1.41
	I 96	0.65	1.61	1.23	1.59
	II 96	-1.76	-0.4	-0.5	0.29
	III 96	-0.73	0.38	0.12	0.73
	IV 96	-1.08	0.03	-0.37	0.51
	I 97	-0.66	0.33	0.14	-0.18
	II 97	-2.98	-1.74	-1.57	-1.13

		Overall Difference	Fixed Weight	Scope Adjustment	Residual
	(1)	(2)	(3)	(4)	(5)
Difference	I 92	0.46	-0.21	0.06	0.61
Analysis	II 92	1.46	0.29	-0.24	1.41
	III 92	1.64	-0.23	-0.21	2.08
	IV 92	2.19	0.23	-0.37	2.33
	I 93	-0.56	-0.04	-0.11	-0.41
	II 93	1.10	0.29	-0.42	1.23
	III 93	1.44	0.14	-0.49	1.79
	IV 93	1.18	0.27	-0.29	1.20
	I 94	0.06	0.09	0.04	-0.07
	II 94	0.76	0.27	-0.19	0.68
	III 94	0.79	0.30	-0.43	0.92
	IV 94	2.26	0.45	-0.56	2.37
	I 95	1.43	0.55	-0.17	1.05
	II 95	2.23	0.57	-0.13	1.79
	III 95	0.86	0.63	0.21	0.02
	IV 95	1.83	0.71	-0.14	1.26
	I 96	0.94	0.96	-0.38	0.36
	II 96	2.05	1.36	-0.10	0.79
	III 96	1.46	1.11	-0.26	0.61
	IV 96	1.59	1.11	-0.40	0.88
	I 97	0.48	0.99	-0.19	-0.32
	II 97	1.85	1.24	0.17	0.44
	Average	1.25	0.50	-0.21	0.96
	St. Dev.	0.73	0.46	0.21	0.80

Table 3.
Summary of Adjustments to PCE Deflator Nondurable Goods (Line 89 of Table 206I)

		BEA	Fixed Weight	Scope Correction	CPI
	(1)	(2)	(3)	(4)	(5)
Inflation Rates	I 92	1.62	1.67	1.67	1.74
	II 92	2.42	2.39	2.42	2.75
	III 92	2.81	2.64	2.56	2.93
	IV 92	1.2	1.32	1.36	1.27
	I 93	2.26	2.2	2.26	3.29
	II 93	0.39	0.5	0.46	0.91
	III 93	-0.43	-0.52	-0.54	-1.49
	IV 93	2.65	2.51	2.57	2.29
	I 94	-0.16	-0.04	-0.02	0.59
	II 94	1.22	1.27	1.25	0.98
	III 94	4.38	4.34	4.32	4.72
	IV 94	1.28	1.37	1.35	1.16
	I 95	0.77	0.84	0.81	1.42
	II 95	1.77	1.9	1.83	1.84
	III 95	1.5	1.44	1.47	1.53
	IV 95	1.34	1.38	1.37	1.33
	I 96	3.69	3.79	3.84	4.47
	II 96	3.81	4.01	4.04	4.35
	III 96	0.93	1.14	1.11	1.48
	IV 96	3.62	3.85	3.86	4.62
	I 97	2.36	2.28	2.34	2.04
	II 97	0	-0.14	-0.16	-1.74

		Overall Difference	Fixed Weight	Scope Adjustment	Residual
	(1)	(2)	(3)	(4)	(5)
Difference	I 92	0.12	0.05	0.00	0.07
Analysis	II 92	0.33	-0.03	0.03	0.33
	III 92	0.12	-0.17	-0.08	0.37
	IV 92	0.07	0.12	0.04	-0.09
	I 93	1.03	-0.06	0.06	1.03
	II 93	0.52	0.11	-0.04	0.45
	III 93	-1.06	-0.09	-0.02	-0.95
	IV 93	-0.36	-0.14	0.06	-0.28
	I 94	0.75	0.12	0.02	0.61
	II 94	-0.24	0.05	-0.02	-0.27
	III 94	0.34	-0.04	-0.02	0.40
	IV 94	-0.12	0.09	-0.02	-0.19
	I 95	0.65	0.07	-0.03	0.61
	II 95	0.07	0.13	-0.07	0.01
	III 95	0.03	-0.06	0.03	0.06
	IV 95	-0.01	0.04	-0.01	-0.04
	I 96	0.78	0.10	0.05	0.63
	II 96	0.54	0.20	0.03	0.31
	III 96	0.55	0.21	-0.03	0.37
	IV 96	1.00	0.23	0.01	0.76
	I 97	-0.32	-0.08	0.06	-0.30
	II 97	-1.74	-0.14	-0.02	-1.58
	Average	0.14	0.03	0.00	0.10
	St. Dev.	0.65	0.12	0.04	0.58

Table 4.
Summary of Adjustments to PCE Deflator Services (Line 182 of Table 206I)

		BEA	Fixed Weight	Scope Correction	CPI
	(1)	(2)	(3)	(4)	(5)
Inflation Rates	I 92	4.93	5.09	4.54	3.89
	II 92	4.06	3.8	3.38	3.57
	III 92	2.81	2.81	2.29	3.09
	IV 92	4.79	4.72	5.6	4.34
	I 93	3.63	3.67	4.19	3.79
	II 93	3.55	3.54	3.72	4.06
	III 93	2.32	2.34	3.01	3.44
	IV 93	3.31	3.42	3.03	3.53
	I 94	2.71	2.67	3.25	3.34
	II 94	3.22	3.37	2.63	2.90
	III 94	3.35	3.29	2.5	3.03
	IV 94	3.84	3.94	2.66	3.01
	I 95	4.06	4.12	4.06	3.80
	II 95	3.11	3.28	2.78	3.76
	III 95	2.61	2.66	2.6	2.86
	IV 95	2.27	2.33	2.68	3.23
	I 96	2.47	2.58	2.75	3.06
	II 96	3.31	3.46	3.03	3.32
	III 96	3.85	4.04	2.68	3.44
	IV 96	3.4	3.5	3.33	3.13
	I 97	2.64	2.81	3.08	2.97
	II 97	2.24	2.25	2.34	2.84

		Overall Difference	Fixed Weight	Scope Adjustment	Residual
	(1)	(2)	(3)	(4)	(5)
Difference	I 92	-1.04	0.16	-0.55	-0.65
Analysis	II 92	-0.49	-0.26	-0.42	0.19
	III 92	0.28	0.00	-0.52	0.80
	IV 92	-0.45	-0.07	0.88	-1.26
	I 93	0.16	0.04	0.52	-0.40
	II 93	0.51	-0.01	0.18	0.34
	III 93	1.12	0.02	0.67	0.43
	IV 93	0.22	0.11	-0.39	0.50
	I 94	0.63	-0.04	0.58	0.09
	II 94	-0.32	0.15	-0.74	0.27
	III 94	-0.32	-0.06	-0.79	0.53
	IV 94	-0.83	0.10	-1.28	0.35
	I 95	-0.26	0.06	-0.06	-0.26
	II 95	0.65	0.17	-0.50	0.98
	III 95	0.25	0.05	-0.06	0.26
	IV 95	0.96	0.06	0.35	0.55
	I 96	0.59	0.11	0.17	0.31
	II 96	0.01	0.15	-0.43	0.29
	III 96	-0.41	0.19	-1.36	0.76
	IV 96	-0.27	0.10	-0.17	-0.20
	I 97	0.33	0.17	0.27	-0.11
	II 97	0.60	0.01	0.09	0.50
	Average	0.09	0.06	-0.16	0.19
	St. Dev.	0.57	0.11	0.60	0.51

Table 5.
Large Differences in Weights
(in Percentage Points)

CPI ID	Title	100*dw
SE2201	OWNERS' EQUIVALENT RENT	7.22
SE4501	NEW CARS	1.86
SE50	AUTOMOBILE INSURANCE	1.83
SE2101	RENT OF DWELLING	1.66
SE2102	LODGING WHILE OUT OF TOWN	1.52
SE5604	SERVICES BY OTHER MED. PROFESSIONALS	-1.89
SE5601	PHYSICIANS' SERVICES	-2.63
SE57	HOSPITAL AND RELATED SERVICES	-6.39

Table 6.
Largest Weight Effects
(in Index Points)

CPI ID	Title	PdW
SE57	HOSPITAL AND RELATED SERVICES	-1.002
SE5601	PHYSICIANS' SERVICES	-0.228
SE6802	PERSONAL FINANCIAL SERVICES	-0.112
SE58	HEALTH INSURANCE	-0.080
SE4501	NEW CARS	-0.067
SE3103	SOUND EQUIPMENT	0.051
SE43	WATCHES AND JEWELRY	0.052
SE28	TEXTILE HOUSEFURNISHINGS	0.053
SE5301	AIRLINE FARE	0.054
SE6002	OTHER SPORTING GOODS	0.056
SE46	USED CARS	0.067
SE3101	TELEVISION	0.068
SE3102	OTHER VIDEO EQUIPMENT	0.082
SE69	INFORMATION PROCESSING EQUIPMENT	0.097
SE2102	LODGING WHILE OUT OF TOWN	0.110
SE50	AUTOMOBILE INSURANCE	0.148
SE2201	OWNERS' EQUIVALENT RENT	0.172

Table 7.
Largest Differences in Component Price Indexes (in Index points)

BEA Line Number	BEA Line Title	dP
231	Intercity railways	-12.49
190	Tenant landlord durables	-10.65
155	Semi-durable house furnishings	-8.61
166	Stationery & school supplies	-6.46
167	Greeting cards	-6.46
282	Clubs & fraternal organizations	-5.32
88	Pleasure aircraft	-3.92
211	Domestic service, cash	-3.87
229	Taxicab	-2.96
214	Moving & storage	-2.00
222	Household operation NEC	-1.99
228	Net auto insurance premiums	-1.14
185	Owner occupied mobile home	0.96
186	Owner occupied station homes	0.97
196	Elem. & second education housing	1.24
93	Beef & veal	1.59
95	Other meat	1.73
110	Fish & seafood	1.79
98	Poultry	1.83
94	Pork	1.89
101	Fresh vegetables	1.94
174	Lighting supplies	1.98
100	Fresh fruit	2.05
99	Eggs	2.06
147	LP gas & other fuel	2.85
70	Textile products	5.32
236	Physicians	5.41
232	Intercity buses	6.17
244	Nursing homes	8.54
309	Commercial & vocational schools	10.06
307	Nursery schools	11.27
241	For-profit hospitals	12.00
243	Government hospitals	12.06
242	Nonprofit hospitals	15.21
299	Video cassette rental	16.50
306	Elementary & secondary schools	17.19
303	Private higher education	20.37
233	Airline	23.09
65	PCE computers	34.44

Table 8.
Largest Price Effects (In Index Points)

BEA Line Number	BEA Line Title	WdP
155	Semi-durable house furnishings	-0.0526
189	Tenant occupied station homes	-0.0201
282	Clubs & fraternal organizations	-0.0144
190	Tenant landlord durables	-0.0118
166	Stationery & school supplies	-0.0115
167	Greeting cards	-0.0115
211	Domestic service, cash	-0.0100
94	Pork	0.0098
93	Beef & veal	0.0119
307	Nursery schools	0.0125
299	Video cassette rental	0.0262
309	Commercial & vocational schools	0.0363
306	Elementary & secondary schools	0.0681
241	For-profit hospitals	0.0951
65	PCE computers	0.1074
186	Owner occupied station homes	0.1126
244	Nursing homes	0.1148
233	Airline	0.1412
303	Private higher education	0.1521
243	Government hospitals	0.1749
236	Physicians	0.2380
242	Nonprofit hospitals	0.7343

Table 9.
Cumulative Difference, 1992-II 97.

1	CPI, 1992 Annual Average:	140.32
2	CPI, II 97 (Ave. of SA)	160.13
3	Implied II 97 CPI, 1992=100	114.12
4	PCE Deflator, II 97	112.47
5	Total Difference in Index Points (3) - (4)	1.65
6	Fixed Weight Index Using 1992 PCE Weights	113.33
7	Formula Effect (6)-(4)	0.86
8	Scope Adjusted Fixed Weight Index	112.32
9	Scope Effect (8)-(6)	-1.01
10	CPI-Scope Adjusted FW Index (3) - (8)	1.80
11	Weight Effect	-0.16
12	Price Effect	1.97
13	Unexplained Residual	-0.01